2. Attachment P, Monitoring Program:

Replacement Attachment P Text
(replaces cover page through page 7)

FLORENCE COPPER, INC.

UIC PERMIT APPLICATION

FLORENCE COPPER PROJECT – PRODUCTION TEST FACILITY

ATTACHMENT P – MONITORING PROGRAM

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P.1 Introduction

This Attachment has been prepared in support of an application (Application) by Florence Copper, Inc. (Florence Copper) to the United States Environmental Protection Agency (USEPA) for issuance of an Underground Injection Control Class III (Area) Permit (UIC Permit) for the planned Production Test Facility (PTF), to be located at the Florence Copper Project (FCP) in Pinal County, Arizona. Florence Copper is submitting this Application so that it may proceed with the development of the PTF to demonstrate the feasibility of a future full scale in-situ copper recovery (ISCR) facility. This Attachment describes the monitoring program that Florence Copper proposes to conduct in accordance with the monitoring requirements of 40 Code of Federal Regulations (CFR) 146.33(b).

The proposed monitoring program described in this Attachment applies to PTF operations. Elements of the proposed monitoring program closely track the requirements of UIC Permit No. AZ396000001 and will be described in the order of the requirements set forth in 40 CFR 146.33(b).

P.2 Injectate (Lixiviant) Fluid Monitoring

P.2.1 Background Information

40 CFR 146.31 describes regulatory criteria and standards applicable to Class III wells. Specific to characterizing injected fluids, Subsection 146.33(b)(1) requires a permittee to:

- Monitor the nature of injected fluid with sufficient frequency to yield representative data of fluid characteristics, and
- Obtain a new analysis whenever the injected fluid is modified to the extent that the existing analysis data is incorrect or incomplete.

40 CFR 146.34 describes information that the Director will consider in authorizing Class III wells. Subsection 146.34(a)(7)(iii) describes the operating data to be considered; specifically, for the permittee to provide a qualitative analysis and ranges in the concentrations of all constituents in the injected fluids.

The requirements related to injected fluids primarily apply to the acidified solutions injected into the oxide zone for the purpose of recovering copper. Florence Copper proposes that the term "lixiviant" be used to refer to raffinate that has been prepared for injection. Raffinate is the term generally used to describe pregnant leach solution (PLS) from which copper has been extracted in a solvent extraction/electrowinning (SX/EW) plant. It is sometimes referred to as "barren" PLS. The composition and constituent concentrations of PLS and raffinate are similar except that raffinate typically has 90 percent less copper and a lower pH than PLS.

The forecast lixiviant composition is presented in Attachment H of this Application. The forecast composition includes pH, total dissolved solids, and inorganic constituents. UIC Permit No. AZ396000001 prohibited the injection of fluids not described in the permit unless the permittee provides a 30-day advance notice of the proposed change in solutions and receives written approval for those changes from the USEPA. The permit also required a groundwater monitoring program that includes all the constituents in the injected fluid. The groundwater monitoring program will be expanded to include additional constituents approved by USEPA, when such approvals are granted.

Difficulties in forecasting the composition and concentrations of inorganic constituents in lixiviant solutions that can provide the certainty contemplated by the advance notice requirements are discussed in Attachment H of this Application. In particular, Section H.6 briefly describes two studies that were conducted to forecast ranges of inorganic constituent concentrations that can be expected throughout the life of PTF operations. As explained in Section H.6, the studies were limited because of the lack of data from site-specific PLS and raffinate generated from contact with the oxide zone for a long enough period of time to achieve equilibrium conditions. Such solutions are needed to complete the forecasts. One of the key objectives of PTF operations is to produce mature PLS and raffinate that can be used to obtain the necessary data.

Florence Copper anticipates sufficiently mature PLS and raffinate can be produced within 14 months after commencing PTF operations, and will continue PTF operations long enough to produce the needed data from sufficiently mature PLS and raffinate. Florence Copper will conduct an extensive sampling and analysis program during PTF operations to gather this information.

As explained in Section H.6 of Attachment H of this Application, the advance notice requirements are not as problematic for the organic constituents as they are for the inorganic constituents. The program for monitoring injected fluids is therefore divided into two components. The component for organic constituents will track existing requirements embodied in UIC Permit No. AZ396000001, whereas the component for inorganic constituents will focus on developing the data needed to forecast ranges of constituent concentrations during full-scale ISCR operations. The two components are described in Sections P.2.2 and P.2.3 in this Attachment.

The monitoring program will begin when operation of the PTF commences and PLS and raffinate begin to be generated. The monitoring program will continue throughout PTF operations.

P.2.2 Monitoring Organic Constituents in Injectate (Lixiviant) Solutions

Monthly monitoring of lixiviant solutions will be conducted for organic constituents. Because a type of kerosene is used in the SX/EW process, Florence Copper proposes to analyze the lixiviant solution for polynuclear aromatic hydrocarbons (PAHs). As stated in UIC Permit No. AZ396000001, the quarterly average of the total organic constituent concentration may not exceed 10 milligrams per liter (mg/L). The list of organic constituents will be expanded if other organic constituents are included in a change of lixiviant approved pursuant to the permit, or if other organic constituents are present or could be present in the raffinate.

P.2.3 Monitoring Inorganic Constituents in Injectate (Lixiviant) Solutions

During PTF operations, samples of PLS and any lixiviant solution produced via the operation of the temporary SX/EW plant will be collected and analyzed at least monthly for constituents listed in Table 3.1 of Exhibit H-1 of Attachment H. Once a sufficiently mature PLS is produced, the PLS data will be used in geochemical models to forecast constituent concentration ranges for PLS over the life of the future ISCR operations. The forecast ranges for PLS will then be used to develop forecast constituent concentration ranges in the lixiviant solution in accordance with 40 CFR 146.34(a)(7)(iii). A report will be submitted to USEPA which includes the sampling results, a discussion of the geochemical modeling, the results of the modeling, and the forecast composition and range of constituent concentrations for PLS, raffinate, and lixiviant solution.

P.3 Monitoring of Injection Pressure and Flow Rates

40 CFR 146.33(b)(2) requires semi-monthly monitoring of injection pressure and either flow rate or volume, or metering and daily recording of injected and recovered fluid volumes, as appropriate. Florence Copper will monitor injection flow rates and pressures in accordance with these requirements, and as described in detail in Attachment K of this Application. The procedures described in Attachment K include descriptions of equipment located at individual injection and recovery wells and the manifolds serving the wells to monitor flow rates and injection pressures. Injection pressure will also be monitored at each injection well head. Both injection and recovery well flow rates will be measured and recorded at least every 24 hours as part of procedures for monitoring hydraulic control. Monitoring of hydraulic control will be done by measuring and comparing total flows into and out of the injection zone. Those flow data will be recorded daily. Manifold pressures will be set to prevent allowable injection pressures from being exceeded and will be monitored daily to ensure that the allowable pressures are not exceeded.

Table 1 of Exhibit K-2 of Attachment K shows monitoring devices to be placed on injection and recovery wells, manifolds, tanks, and hydraulic control monitoring wells. For each device, the Table identifies contingency conditions and response actions. During PTF operations, monitoring may occur at wells in the event that manifolds are determined to be impractical for the small number of wells that will be operating.

P.4 Demonstration of Mechanical Integrity

Pursuant to 40 CFR 146.33(b)(3), the permittee is required to demonstrate mechanical integrity pursuant to 40 CFR 146.8 at least once every five years for certain wells. Mechanical integrity will be demonstrated before new injection or recovery wells are placed in service; at least once every five years; and any time that a workover is conducted, well construction is modified, or loss of integrity becomes obvious during operation. Annular conductivity monitoring will be conducted on a quarterly basis at observation and multi-level sampling wells. Both aspects of mechanical integrity testing and associated response procedures are described in Section O.3 of Attachment O of this Application.

P.5 Groundwater Monitoring

Pursuant to 40 CFR 146.33(b)(4), permittees are required to monitor fluid levels in the injection zone. Groundwater levels will be monitored as part of monitoring hydraulic control, as described in Attachment K of this Application. The remaining elements of the monitoring program are presented below.

P.5.1 Groundwater Quality Monitoring

As required by UIC Permit No. AZ396000001, quarterly and biennial samples have been collected since that permit came into effect, except during 2009 due to the financial difficulties of a prior owner.

In accordance with UIC Permit requirements, and requirements of Aquifer Protection Permit (APP) No. 106360, groundwater quality will be monitored at point-of-compliance (POC) wells. Figure P-1 shows the locations of the existing POC wells, the locations of approved (but not yet drilled) replacement and additional POC wells, and the locations of planned operational and supplemental monitoring wells. Replacement POC well M52-UBF is proposed to replace well M32-UBF, which is no longer functional because of the declining water table in the area. The well was specifically located to monitor for potential effects of the SX/EW plant and other surface facilities required for commercial operations proposed by BHP Copper in conjunction with UIC Permit No. AZ396000001. All of the POC wells proposed to monitor surface facilities during PTF operations are located outside the PTF well field area and outside of the requested area of review (AOR). Supplemental monitor wells requested by USEPA and the operational monitor well requested by ADEQ are located outside of the PTF well field area, and inside the requested AOR.

Selected additional figures are provided in Exhibit P-2. Figures included in Exhibit P-2 are identified as *Figure 11-1, Figure 11-2, Figures 12-1 through 12-4, and Figure M1-1* and depict POC, operational monitoring, and supplemental monitoring well locations and well construction details. USEPA has requested that these maps and figures also be provided in Exhibit P-2 for the reviewers' convenience.

Tables P-1 through P-4 provide details about Florence Copper's program for monitoring groundwater quality at POC wells, and Table P-5 provides details about monitoring groundwater quality at the operational monitoring well (MW-01) as required by Section 2.5.8 of APP No. 106360. Table P-1 shows the aquifer units in which the existing POC wells were completed and the location coordinates for each of the existing wells. Table P-2 shows the aquifer units in which the approved (but not yet constructed) POC wells, the operational monitoring well, and supplemental monitor wells are to be completed and the location coordinates for each well. Tables P-3 and P-4 show Aquifer Quality Limits (AQLs) and Alert Levels (ALs) for assessing groundwater quality sampled at POC and supplemental monitoring wells. Table P-3 lists Level 1 parameters (parameters that will be monitored quarterly), and Table P-4 lists Level 2 parameters (parameters that will be monitored semi-annually). The ALs and AQLs shown in Tables P-3 and P-4 are site-specific ALs and AQLs established by ADEQ and embodied in APP No. 106360 issued on September 28, 2012 and amended on July 5, 2013. The ALs and AQLs are listed in Tables 4.1-6 and 4.1-7 of APP No. 106360, which is included as Exhibit Q-1 of this Application. Exhibit P-1 of this Attachment describes the method by which ALs and AQLs have been determined for existing POC wells, and will be determined for the proposed POC wells. Table P-5 lists parameters and frequency of monitoring to be conducted at operational monitoring well MW-01 as defined and required by Section 2.5.8 of APP No. 106360.

The monitoring of Level 1 and 2 ALs for pH are shown in Tables P-3 and P-4 as being limited to field measurements because the hold time now required for valid pH measurements can only be met by measurements in the field.

P.5.2 Hydraulic Control Monitoring

Hydraulic control monitoring will be verified by measuring water levels at least daily at four locations approximately equidistant around the perimeter of the PTF well field. At each location, an observation well equipped with a pressure transducer will be paired with the nearest recovery or perimeter well, which will also be equipped with a pressure transducer. Hydraulic control will be assessed by measuring water levels in the paired wells. Hydraulic control will be deemed to exist if the water level in each observation well, located more distant from the PTF well field than the recovery wells, is higher than the water level in its paired recovery well.

P.5.3 Annular Conductivity Monitoring

Florence Copper will establish an annular conductivity baseline for each new Class III well equipped with polyvinyl chloride (PVC) or fiberglass reinforced plastic (FRP) outer casings before the well is used for multi-level sampling or water level observation. Wells constructed with PVC or FRP outer casing will not be used for injection, recovery, or hydraulic control pumping. Annular conductivity devices will not be installed on wells with steel outer casings. Additionally, Florence Copper will perform conductivity measurements at each such well quarterly thereafter, until the affected formation is closed in accordance with APP and UIC Permit requirements. Significant increases in conductivity over the last period of monitoring may be an indication of injected fluids migrating through the annular space. Annular conductivity monitoring and associated response procedures are described in Section O.3.1.2 of Attachment O of this Application.

P.5.4 Demonstration of Hydraulic Control

UIC Permit No. AZ396000001 required that hydraulic control be demonstrated during initial injection to verify the adequacy of hydraulic control. BHP Copper conducted a test for this purpose in late 1997 and early 1998. The test involved the injection and recovery of in-situ solutions in a test well field located at the FCP property. BHP Copper was able to demonstrate that hydraulic control could be maintained at all times with the use of wells installed and operated according to the same basic design as proposed by Florence Copper. During PTF operations, Florence Copper will monitor hydraulic control on a daily basis, and will take actions outlined in the Operations Plan to ensure that hydraulic control is maintained.

P.5.5 Injectate (Lixiviant) Solution Monitoring

Lixiviant solution monitoring will be performed as described in Section P.2 of this Attachment.

P.5.6 Mine Shaft Conductivity Monitoring

UIC Permit No. AZ396000001 required conductivity monitoring of water within an old mine shaft that was advanced by a previous owner of the FCP property. During PTF operations, no injection or recovery wells will be located within 500 feet of the shaft. The mine shaft is outside of the Area of Review described in Attachment A of this application. Florence Copper does not propose to monitor conductivity of mine shaft water during PTF operations.

P.6 Manifold Monitoring

As described in Section P.3 above, each injection and recovery well will be equipped with individual monitoring devices and controls connected to manifolds equipped with similar devices and controls. Fluid volumes and rates will be monitored and controlled at individual wells, and at the injection and recovery manifolds as described in the Operations Plan included in Exhibit K-2 of Attachment K of this Application.

P.7 Reporting and Maintenance of Records

Reporting of information obtained from the monitoring program described in this Attachment and the maintenance of related records will be in accordance with the requirements of the UIC Permit issued by USEPA for PTF operations. For consistency, Florence Copper proposes that the permit include the same or similar reporting and maintenance of records requirements as stipulated in UIC Permit No. AZ396000001.